Emotions in the Age of Automated Driving

Developing Use Cases for Empathic Cars

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ABSTRACT

Improving user experience of highly automated vehicles is key to increase their acceptance. One possibility to realize this is the design of empathic cars that are capable of assessing the emotional state of vehicle occupants and react to it accordingly by providing tailored support. At the moment, the central challenge is to derive relevant use cases as basis for the design of future empathic cars. Therefore, we propose a workshop that aims to bring together researchers and practitioners interested in affective computing, affective interfaces and automated driving as forum for the development of a roadmap towards empathic vehicles using design thinking methods. During the workshop, we will gain a common understanding of the central concepts and listen to impulse talks about current and recent projects on emotions during automated driving. Based on this, relevant use cases are generated in group work and discussed with the goal to identify potential research and knowledge gaps. Finally, a road map for research towards the realization of automated empathic cars is formulated from the results.

CCS CONCEPTS

Human-centered computing → User-centered design

KEYWORDS

Empathic vehicles, emotions, user acceptance, interaction design, human-centered computing, affective computing

Motivation and Goal

In-car emotion detection and regulation have become an emerging and important branch of research within the automotive domain. Different emotional states can greatly influence human driving performance and user experience today in manual driving, but still in future automated driving conditions. The sensing and acting upon relevant emotional states is therefore important to avoid critical driving scenarios with the human driver being in charge, and to ensure comfort, acceptance, and to enrich the user experience in autonomous driving (Fig. 1).
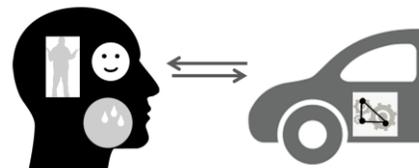

Figure 1: Schematic illustration of an empathic car (DLR).

With the evolving development of progressively automated cars, i.e., high and full automation respectively SAE levels 4 and 5, the role of a nowadays car driver executing the driving task or at least monitoring the automation and simultaneously the driving environment is turning gradually into the future role of a mere

user or passenger of the automated system. Prospectively, a car driver does not even have to serve as a fallback instance in cases of automated system failure. Therefore, the current primary task of self-driving will become increasingly irrelevant and the nowadays secondary tasks are turning into prospective primary tasks the user will be allowed to exclusively focus on. This raises questions of changing interplays in human-car interaction resulting in prospectively new affective use cases and hence the needs for different user-centered empathic Human-Machine Interfaces (HMI). This is the motivation of this workshop and hence we will focus on the role of emotions for user experience and user acceptance in the context of highly automated driving. Within this context, the central goal will be to detect and discuss crucial use cases for empathic cars thereby providing a roadmap of future research and applied issues of designing user-centered empathic cars for future mobility.

Audience and Procedure

This workshop is intended for Human-Machine (HMI) and Human-Computer Interaction (HCI) researchers as well as for User Experience (UX) and Usability practitioners, designers and developers in the field of automotive HMI and interest in designing empathic cars within highly automated driving. It provides a forum for exchange and discussion on empathic user interfaces, including methods for emotion recognition and regulation, empathic automotive human-machine interaction design, user evaluation and measurements, and subsequent improvement of autonomous driving experience.

Throughout the workshop we will follow a Design Thinking procedure. After a brief round of introductions, we will introduce the research area with definitions of automated driving, emotions and possibilities of in-car emotion recognition. This is intended to set a base and common understanding for the collaboration process in the ongoing workshop [1, 2, 3, 4]. In a second step, we will present challenges and boundaries of cutting-edge research methods and results in the field of emotion detection and regulation within affective automotive HMI to empathize participants for the next step of collaboration [5]. In a third step and as a cardinal point of the workshop, the participating multidisciplinary researchers and practitioners will work in small groups on prospective relevant use cases and critical scenarios for emotions in the age of automated driving. Here, participants will share experiences and ideas as well as they will discuss design and technology goals for the future. These use cases might be related to user acceptance, user experience, trust, and hedonic aspects (Fig. 2). In a final step, we will discuss the groups' results for future use cases leading to prospective research directions, address their challenges and opportunities, and we will develop ideas on how to tackle them. Ultimately, a road map on how to continuously improve automotive HMI design in the age of automated driving by emotion recognition and regulation will be designed throughout the workshop.

Figure 2: Prospective use case in an automated car (BMW).

Organizers

The organizers are experienced researchers in user-centered automotive HMI. They have organized similar scientific or applied workshops before [6] serving as sources for this one:

Michael Oehl is a senior HMI researcher and expert at the German Aerospace Center (DLR) and a senior lecturer for Traffic Psychology at the German Police University. His research focuses on emotions in traffic and intelligent HMI.

Klas Ihme is a postdoctoral human factors researcher at DLR with a background in cognitive science focusing on driver and user affective state monitoring.

Esther Bosch is a human factors researcher at the German Aerospace Center (DLR) especially interested in driver emotion recognition.

Anna-Antonia Pape is an applied cognitive neuroscientist. She focuses on detecting mental states relevant for HMI in the automotive context.

Mathias Vukelić is a senior scientist at IAT, University of Stuttgart, and Fraunhofer IAO aiming at understanding human motivation, emotions, and their underlying brain functions to improve HMI.

Michael Braun works on user-aware interfaces at BMW Research and LMU Munich. He creates in-car HMI which adapts to the driver's personality and emotional state.

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